Claims 1, 2, 3, 8, 19-22, and 35 were rejected under 35 USC § 103(a) as being unpatentable over German Patent Document 28 05 438 (the '438 patent) and U.S. Patent No. 4,255,684 to Mischler et al.

The '438 patent discloses a motor comprising an iron core made of layers. The iron core consists of separate parts, which form joints having variable reluctance elements inserted therein. Strips of non-magnetic materials such as plastic foil hold the joints apart. Each of the joints opens out to form a large rectangular window near the inner face, which may be used to hold coil windings. In operation, the flux must cross an air gap between the ends of a back and a tooth section. This disclosure does not teach that the metal used is an amorphous metal. Thus, the '438 patent teaches a conventional, crystalline metal stator wherein the flux must cross at least one (and most likely more than one) air gap.

Mischler et al discloses a stator structure for use in a motor which is fabricated using strip material and moldable magnetic composite, either amorphous metal tape and amorphous flake or similar conventional materials.

The Examiner has indicated that each of the back iron sections in the '438 disclosure has a top and a bottom surface which has a line normal to the surface being perpendicular to the axis of rotation of the rotor. Referring now to the Figure of the '438 German Patent, applicants respectfully submit that there is disclosed a generally cylindrical stator for use in a motor having a rotor appointed to rotate generally about the cylindrical axis of the stator. Applicants acknowledge that the Figure of the '438 patent depicts back iron sections in which a line normal to the surface of the layers of the back iron sections is perpendicular to the cylindrical axis of the stator. However, each of applicants' claims 1, 2, 3, 8, 19-22, and 35 recites a stator comprising a plurality of segments, each comprised of a plurality of strips having a top and a bottom surface. In addition, each claim calls for a line normal to either surface at substantially any point thereon to be substantially perpendicular to the axis of rotation of the rotor. More specifically, the term "surface" is set forth in

the claims with reference to the strips used in the construction of each segment of the stator. Applicants respectfully submit that this requirement clearly calls for the perpendicularity to be satisfied for the strips present in all segments comprised in the claimed stator, not just for some segments. Clearly, the stator depicted in the Figure of the '438 German Patent comprises pole shoes (3) that include layers of steel having top and bottom surfaces oriented such that any line normal to either surface of the layers therein is parallel to, and not perpendicular to, the stator's cylindrical axis, which is also the axis of rotation of the rotor to be associated with the stator. In this respect, the teaching of the '438 German Patent points away from the stator recited by applicants' claims 1, 2, 3, 8, 19-22, and 35. In contrast to the teaching of the '438 German Patent, each of applicants' claims 1, 2, 3, 8, 19-22 and 35 requires that every segment therein be comprised of layers oriented with their normal direction perpendicular to the rotor axis. The Examiner has not pointed to any teaching in the '438 patent that would disclose or suggest any stator structure in which every segment, including the pole shoes, is comprised of layers of material oriented perpendicular to the rotor axis, instead of parallel as depicted in the Figure.

Applicants' claimed stator has exceptional magnetic properties, notably including low core loss, that render a motor constructed therewith highly efficient and capable of high-speed operation not possible with motors incorporating previously known magnetic components. As a result, a motor constructed with the stator defined by applicant's claims 1, 2, 3, 8, 19-22, and 35 achieves higher power than previous motors of the same size and weight, while retaining higher efficiency. Moreover, the structure of the stator defined by present claims 1, 2, 3, 8, 19-22, and 35 lends itself to highly efficient and cost-effective manufacture and, for this reason is especially suited to be incorporated in a high efficiency electric motor.

Recognizing that the '438 German Patent does not disclose a stator comprised of amorphous metal, the Examiner has combined its teaching with the Mischler et al. reference. The Examiner has

stated that Mischler et al. teaches a stator for a motor with a plurality of segments formed from amorphous metal.

This statement of the Examiner is, respectfully, traversed. Figure 1 of the Mischler reference depicts a stator having yoke structures 11 and 12 constructed of layers of continuous flat amorphous strip 13 and <u>amorphous composite pole pieces</u> 18 and 19. These pole pieces are <u>not</u> constructed of amorphous metal strips, and are instead said to be "amorphous metal flake or filament composite in a binder" (col. 1, lines 63-64). The path of magnetic flux is labeled "FLUX" in Figure 1 and clearly fails to traverse any air gap.

By way of contrast, the stator defined by present claim 1 is comprised of segments, <u>each</u> of which comprises a plurality of layers of <u>amorphous metal strips</u>. Moreover, flux traversing the segment <u>crosses one air gap</u>. Neither of these conditions is satisfied by any stator disclosed or suggested by Mischler et al. Accordingly, the structure of applicants' claimed stator is not suggested by Mischler or the '438 German Patent, either individually or collectively. In this respect, Mischler et al. does not suggest modification of any structure taught by the '438 reference to produce the stator required by each of applicants' claims 1, 2, 3, 8, 19-22, and 35.

Furthermore, Mischler et al. disclose an amorphous metal stator typical of the prior art. In Mischler et al.'s stator, adjacent teeth (for example, as shown in Fig. 7 of Mischler et al., the tooth at 12 o'clock and the tooth at 3 o'clock) connected by a continuous backiron segment (shown at 38 in Mischler et al.'s Fig. 7) are magnetized simultaneously. In this manner, flux travels along a continuous segment (from the right side of the 12 o'clock tooth, through the backiron, to the top side of the 3 o'clock tooth), and does not have to jump across an air gap. This teaching of Mischler et al. <u>points away</u> from the stator called for by applicants' claims 1, 2, 3, 8, 19-22, and 35, wherein a plurality of teeth (for example, the tooth at 12 o/clock and the tooth at 6 o'clock) are <u>magnetized simultaneously</u>, and the <u>flux must jump</u> across the gap between the top and bottom sections of the 3 o'clock tooth. Furthermore, Mischler et al. does not disclose any stator structure having other than

"continuous flat amorphous strip" (col. 2, lines 59-60) or provide any suggestion that would motivate the skilled person to construct applicants' claimed stator, which comprises a plurality of segments that, of necessity, create a magnetic flux path having an air gap.

For these reasons, it is respectfully submitted that the proposed combination of the '438 disclosure and Mischler et al. does not disclose or suggest the stator structure required by claims 1, 2, 3, 8, 19-22, and 35. Specifically, each of claims 1, 2, 3, 8, 19-22, and 35 requires a stator having a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap.

The Mischler et al. limitation that the flux does not jump an air gap places severe restrictions on the performance of their motor. If a continuous segment of the Mischler et al. motor is magnetized (for example, the segment 38 in Mischler et al.'s Fig. 7), then only the right half of the 12 o'clock tooth and the top half of the 3 o'clock tooth are magnetized. The other halves of the 12 o'clock and 3 o'clock teeth represent parts of different, unmagnetized, segments. Effectively, only half of the volume of each tooth is magnetized. Therefore, if segment 38 is magnetized to 1.5 T, the 12 o'clock tooth will perform as if the entire tooth were magnetized to only 0.75T. This would provide half the torque of a tooth fully magnetized to 1.5T.

Clearly, the Mischler et al. limitation that the flux does not jump an air gap places restrictions on the combinations of frequency, speed and torque at which their motor operates. These restrictions have heretofore caused amorphous metal stators to be considered unsuitable for conventional motor applications. On the other hand, these restrictions have been eliminated by the stator called for by present claims 1, 2, 3, 8, 19-22, and 35. In contrast to any motor constructed from the teaching of the '438 patent, modified in view of by Mischler et al., the stator called for by applicants' claims 1, 2, 3, 8, 19-22, has back iron and teeth arranged such that radial flux passing

though the stator crosses just one air gap when traversing each segment of the stator. Overall versatility of the motor is improved; operational ranges and levels of speed, frequency and torque are increased. When compared with any stator constructed from the combined teachings of the '438 patent and Mischler et al., the stator recited by present claims 1, 2, 3, 8, 19-22, and 35 is smaller, lighter, much less expensive to construct and far more versatile and efficient in operation.

Applicants respectfully submit that it was not obvious to manufacture an amorphous metal rotor having the structure of the '438 patent. Had it been obvious to do so, Mischler et al. and other prior art workers would have attempted to combine the teachings of the cited references and realized the significant advantages afforded by the stator delineated by applicants' claims. Clearly, up to the time of applicants' invention, no stator having the structure called for by claims 1, 2, 3, 8, 19-22, and 35 has been proposed by any prior art worker, including those represented on the '438 disclosure and Mischler et al. The prior art stators and their attendant disadvantages are discussed at pages 1 and 2 of the specification. It is submitted that the proposed combination of the '438 disclosure and Mischler et al. can be made only in light of applicants' own disclosure. Even then, any stator constructed from the combined teachings of the '438 disclosure modified in light of Mischler et al. would require substantial reconstruction and redesign which is not fairly taught by the references.

Assuming, arguendo that the '438 patent could be combined with Mischler et al., the resultant stator would still not possess a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) when traversing said segment, said flux crosses one air gap.

Rather, any stator constructed from the teachings of the cited references would be governed by Mischler's limitation that <u>the flux does not jump an air gap</u>. Restrictions placed on the

combinations of frequency, speed and torque of such a stator by this limitation would render it unsuitable for many conventional motor applications. These restrictions have been eliminated by the amorphous metal stator called for by applicants' claims 1, 2, 3, 8, 19-22, and 35, which is smaller, lighter, less expensive to construct and more versatile and efficient in operation than any stator produced from the combined teachings of the cited references.

The Examiner has further indicated that heat treatment; application of a magnetic field, and annealing are methods of making limitations not germane to the patentability of the apparatus. Applicants respectfully submit that each of the heat treatment and annealing requirements structurally alter the stator recited in claims 19-21; and that this is so whether or not a magnetic field is applied. Consequently, it is respectfully submitted that the heat treatment, application of a magnetic field and annealing requirements are properly germane to the determination of patentability of those claims. As set forth in the specification, e.g. at page 15, lines 7-16, heat treatment enhances the magnetic properties of the amorphous metal strip used in constructing the stator recited by claims 19-21. Moreover, the specification teaches that different forms of heat treatment result in different microstructures within the metal strip. The heat treatment recited at page 15, lines 10-11 modifies a substantially glassy or amorphous microstructure, whereas the heat treatment presented at page 15, lines 17-19 results in the formation of a nanocrystalline microstructure characterized by the presence of a high density of grains having average size less than about 100 nm. The specification teaches that each of these methods constitutes means for improving the magnetic properties of the amorphous metal strip, notably the core loss. A motor comprising a stator having low core loss operates with high efficiency and speed, low production of waste heat, and minimized need for auxiliary cooling means. The significance of low core loss is set forth in the specification, especially at page 16, line 30, through page 17, line 7, and is further discussed hereinbelow in conjunction with the rejection of claims 15-18 and 26-33 over the '438 patent and Mischler et al.

Moreover, claims 19 to 21 depend from claim 1, which is submitted to be patentably unobvious over any combination of Mischler et al. and the '438 German patent, for the reasons set forth hereinabove. It is therefore submitted that dependent claims 19 to 21 are also patentable for at least the same reasons.

In view of the above remarks, applicants respectfully submit that the structural features of the stator are correctly characterized by claims 19-21 and provide proper basis defining patentably over the cited references. Further, it is submitted that the advantageous features afforded by the stator of present claims 1, 2, 3, 8, 19-22, and 35, including <u>significant reductions in size and weight, lower construction costs</u> and <u>increased versatility</u> and <u>efficiency of operation</u>, provide ample basis upon which to predicate their patentability over the art applied.

Accordingly, reconsideration of the rejection of claims 1, 2, 3, 8, 19-22, and 35 under 35 USC §103(a) as being unpatentable over the combination of the '438 patent and Mischler et al. is respectfully requested.

Claims 4, 5, and 23 have been rejected under 35 USC §103(a) as being unpatentable over the '438 disclosure and Mischler et al. in further view of U.S. Patent No. 2,556,013 to Thomas, which discloses dynamoelectric motors having stator members provided with salient field poles. The stators have an outer cylindrical protective and retaining member, which is made of a non-magnetic material with good tensile strength qualities such as aluminum or stainless steel.

The Examiner has indicated that the '438 patent and Mischler et al. teach every aspect of the invention except a steel band peripherally around the stator. This indication is respectfully traversed.

As discussed hereinabove in connection with the 103(a) rejection of claims 1, 2, 3, 8,19-22, and 35 over the '438 patent and Mischler et al., present claim 1 calls for a stator comprised of segments, each of which comprises a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at

substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Even taking the '438 patent and Mischler et al. teaching together, there is not produced any suggestion whatsoever concerning a stator structure that satisfies the combined requirements of provisos (i) and (ii).

The Examiner has indicated that it would be obvious to construct a stator of the type defined by the '438 patent and Mischler et al. with the steel band disclosed in Thomas. Like Mischler et al., Thomas does not disclose or suggest an amorphous metal stator wherein the flux crosses only one air gap. Thomas also teaches a stator composed of stacked laminations, each having a surface whose normal is parallel, not perpendicular, to the axis of rotation of the rotor with which the stator is associated. Further, Thomas does not teach an amorphous metal stator that is not brittle, and which exhibits increased magnetic permeability and overall efficiency without adverse thermal characteristics. In this respect, Thomas does not add to the teaching of the '438 patent and Mischler et al. and cannot be combined therewith to render obvious the invention recited by claims 4, 5, and 23. When compared to any stator constructed in view of the teaching of the '438 patent, modified in light of Mischler et al. and further modified in light of Thomas, the stator required by present claims 1, 2, 3, 8, 19-22, and 35 exhibits increased economy of construction and improved operating versatility and efficiency.

Accordingly, reconsideration of the rejection of claims 4, 5, and 23 as being unpatentable over the combination of the '438 patent, Mischler et al. and Thomas is respectfully requested.

Claims 6, 7, 24, and 25 were rejected under 35 USC § 103(a) as being unpatentable over the '438 patent, Mischler et al., Thomas, and further in view of U.S. Patent No. 3,591,819 to Laing.

The Examiner has indicated that the '438 patent, Mischler et al., and Thomas teach every aspect of the invention except the bonding material being an epoxy resin and the inner restraining member being a bonding material and a metal band. For the reasons set forth above in conjunction with the rejection of claims 4, 5, and 23 under 35 USC § 103(a) over the '438 patent, Mischler et

al., and Thomas, applicants respectfully traverse this statement. It is submitted that Thomas does not cure the lack of disclosure in the '438 patent and Mischler et al. concerning a stator comprising amorphous metal strips oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap.

The Examiner has indicated that it would be obvious to construct the stator of the '438 patent, Mischler et al. and Thomas with the synthetic resin taught by Laing. Applicants submit that even if the combination proposed by the Examiner were made, such a stator would lack the advantageous structure and properties exhibited by the stator defined by claims 6, 7, 24, and 25.

Like Mischler et al. and Thomas, Laing does not disclose or suggest amorphous metal stators wherein the flux crosses only one air gap. Like Thomas, Laing also teaches a stator composed of stacked laminations, each having a surface whose normal is parallel, not perpendicular, to the axis of rotation of the rotor with which the stator is associated. Further, Laing does not teach an amorphous metal stator which is not brittle, and which exhibits enhanced magnetic permeability and overall efficiency without adverse thermal characteristics. In this respect, Laing does not add to the teachings of the '438 patent, Mischler et al. and Thomas, and cannot be combined therewith to render obvious the invention recited by present claims 6, 7, 24, and 25. Any stator constructed from the combined teachings of the '438 patent, Mischler et al., Thomas and Laing would lack the structure and advantageous properties of the stator delineated by present claims 6, 7, 24, and 25, and as such would be far more expensive to construct and operate.

The Examiner has stated that applicants are not viewing the cited references in combination. This statement is, respectfully, traversed. With respect to the rejection of claims 6, 7, 24, and 25, the Examiner's has indicated that '438, Mischler et al., and Thomas teach every aspect of the invention except the bonding material being an epoxy resin and the inner restraining member being a bonding material and a metal band. Laing is said to disclose a laminated stator having a plurality of sections,

where the sections are held together by a synthetic resin and a rivet. As set forth above in connection with the rejection of claims 4, 5, and 23, even when combined in the manner proposed by the Examiner, the '438 patent, Mischler et al., and Thomas references fail to disclose the stator structure recited by independent claims 1 and 22, from which claims 6, 7, 24, and 25 depend. The Examiner has not pointed to any teaching in Laing that cures this deficiency or any suggestion in Laing that would motivate a skilled artisan to modify the combined teaching of the '438 patent, Mischler et al., and Thomas references to produce the structures required by present claims 6, 7, 24, and 25. For these reasons, it is submitted that applicants' interpretation of the references, as well as applicants' arguments herein, which are submitted to provide ample basis for predicating patentability thereover, are consistent with the reference combinations proposed by the Examiner, and cannot be properly said to result from an interpretation wherein the references are applied individually.

Accordingly, reconsideration of the rejection of claims 6, 7, 24, and 25 as being unpatentable over the combination of the '438 patent, Mischler et al., Thomas and Laing is respectfully requested.

Claims 9 and 34 have been rejected as being unpatentable over the '438 patent and Mischler et al. in view of U.S. Patent No. 4,197,146 to Frischmann. The Examiner has indicated that it would have been obvious to construct the stator of the '438 patent and Mischler et al. with the amorphous metal composition disclosed in Frischmann.

Like Mischler et al., Frischmann does not disclose or suggest an amorphous metal stator wherein the flux crosses only a minimum number of air gaps. In addition, the stator disclosed by Frishmann requires that the flux cross many air gaps, that is, the gaps between the compacted, discontinuous flakes. As a result, the Freshmann stator is inherently incapable of exhibiting enhanced magnetic permeability and overall efficiency without adverse thermal characteristics. While Frischmann discloses an amorphous metal composition for fabricating electrical magnetic

components, his stator lacks the advantageous features afforded by the stator called for by applicants' claims 9 and 34. Moreover, Frischmann does not remedy the lack of disclosure in the '438 patent and Mischler et al. concerning the particular orientation of amorphous metal strips called for by claims 9 and 34. In these respects, Frischmann does not add to the teaching of the '438 patent and Mischler et al., and cannot be combined therewith to render obvious the invention recited by claims 9 and 34.

Accordingly, reconsideration of the rejection of claims 9 and 34 under 35 USC §103(a) over the combination of the '438 patent, Mischler et al. and Frischmann is respectfully requested.

Claims 10 and 11 have been rejected as being unpatentable over '438, Mischler et al., and Frischmann in further view of U.S. Patent No. 4,409,041 to Datta et al. The Examiner has indicated that '438, Mischler et al., and Frischmann teach every aspect of the invention except the FeBSi formula and that it would have been obvious to construct the stator of '438, Mischler et al., and Frischmann with the amorphous metal set forth in claims 10 and 11, because Datta et al. suggest the disclosed compositional range, as well as the disclosed range for enhancing the composition's magnetic properties.

The Examiner's indication that the '438 patent, Mischler et al., and Frischmann teach every aspect of the invention except the FeBSi formula is respectfully traversed, for the reasons set forth above in connection with the remarks on the rejection of claims 10 and 11 under 35 USC §103(a).

The Datta et al. disclosure is directed to an iron-based, boron containing magnetic alloy having at least 85 percent of its structure in the form of an amorphous metal matrix annealed in the absence of a magnetic field at a temperature and for a time sufficient to induce precipitation therein of discrete particles of its constituents. No disclosure or suggestion is provided by Datta et al. of the desirability of using amorphous metal in the construction of electric motor components. Moreover, the disclosure of magnetic properties found in Datta et al. is directed to high frequency properties. Each of the examples in Datta et al. discloses properties measured on a magnetic core having a

closed magnetic path and carried out e.g. at a frequency of 50 kHz and at an induction level of 0.1 T. One skilled in the art would recognize that losses measured in an open magnetic circuit are higher than those seen in a closed path, as discussed in more detail at page 17, lines 20-31 of applicants' specification.

Clearly the Datta et al. disclosure is directed to core applications, not to motors or other rotating devices. Applicants thus submit that one of ordinary skill would not be motivated to combine the Datta et al. disclosure with any of the '438 patent, Mischler et al., and Frischmann. However, even assuming arguendo that the '438 patent, Mischler et al., and Frischmann with Datta et al. could be combined in the manner proposed by the Examiner, the resulting stator would still lack the advantageous structure and properties afforded by applicants' stator, as recited by claims 10 and 11. More specifically, the stator would not contain a structure having a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is <u>substantially perpendicular</u> to the axis of rotation of the rotor, and (ii) when traversing the segment, the <u>flux crosses one air gap</u>. As a consequence, any stator constructed from the combined teachings of the cited references would lack the advantageous magnetic properties, including high induction and low material cost (see page 14, line 29, to page 15, line 5 of applicants' specification) afforded by the stator of present claims 10 and 11. For these reasons, applicants respectfully submit that the stator recited by claims 10 and 11 is patentable over any combination of the '438 patent, Mischler et al., Frischmann, and Datta et al.

Accordingly, reconsideration of the rejection of claims 10 and 11 under 35 USC §103(a) is respectfully requested.

Claim 12 has been rejected under 35 USC §103(a) as being unpatentable over of the '438 patent, Mischler et al., and Frischmann, in further view of U.S. Patent No. 5,922,143 to Vernin et al. The Examiner has indicated that the '438 patent, Mischler et al., and Frischmann, teach every aspect of the invention except nanocrystalline microstructure.

The Vernin et al. patent discloses a process for manufacturing a magnetic core made of an iron-based soft magnetic alloy having a nanocrystalline structure. The alloy is formed into a toroidal magnetic core and heat-treated based on particular conditions determined on the basis of the use envisaged for the magnetic core. No suggestion or disclosure is provided in the Vernin et al patent of application of nanocrystalline alloys in motors or other rotating electrical machinery. As discussed hereinabove in connection with the rejection of claims 10 and 11 over the '438 patent, Mischler et al., and Frischmann, in further view of U.S. Patent No. 4,409,041 to Datta et al., applicants submit that one of ordinary skill would not be motivated to combine the Vernin et al. disclosure, which is directed to magnetic core applications, with any of the '438 patent, Mischler et al., and Frischmann, each of which discloses aspects of electric motor construction.

The Examiner's statement that a motor is in the same field of endeavor as a magnetic device with an amorphous core is respectfully traversed. The art recognizes a clear distinction between magnetic materials, which on one hand, are suitable for use in static core devices (e.g., transformers and inductors), and on the other hand, are suitable for use in dynamic devices (e.g., motors, generators, and other rotating electrical machines). A skilled person would not be motivated to consider both classes of materials on an equal footing, or to infer the desirability of a material for use in one device class from a teaching of the desirability of that material in the context of the other class. More particularly, designers of transformers and motors would recognize different materials as best suited for use in the respective devices.

The distinction arises from fundamental differences in the pattern of magnetization processes occurring during operation of the respective devices. Generally speaking, the time-dependent magnetic excitation in dynamic devices (e.g., motors and generators) varies in both direction and magnitude, whereas the excitation in static devices varies in magnitude, but exhibits little or no directional variation.

More specifically, the vectorial magnetization developed in each volume element of an operating transformer or inductor core is directed along a single direction, which is characteristic for that element. During each AC excitation cycle the magnitude of the magnetization in each volume element varies, most often sinusoidally, but the direction of magnetization in each element remains predominantly along a single spatial direction.[1] As a result, high performance static devices such as transformers and inductors are appropriately designed using magnetic materials whose magnetic properties are anisotropic. Such materials exhibit markedly different magnetic characteristics when magnetically excited in different geometrical directions within the strip plane.

The situation in an operating motor is quite different. In most cases, both the direction and magnitude of magnetization in significant portions of either a rotor or stator may vary continuously as the motor operates. Hence, motor components are ordinarily designed with isotropic materials, i.e., materials whose magnetic behavior is substantially independent of the direction in which they are magnetically excited. For these reasons, it is submitted that the proposed combination of Vernin et al. with the '438 patent, Mischler et al. and Frishmann cannot properly be made in the absence of applicants' own disclosure. Even then, the resultant device would require substantial reconstruction or redesign, which is not fairly taught by the references.

Assuming arguendo that the '438 patent, Mischler et al., and Frischmann references could be combined with Vernin et al. in the manner proposed by the Examiner, the resultant device would still not suggest the stator called for by applicants' claim 12. As discussed hereinabove, applicants' claims call for a stator comprised of segments, each of which comprises a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is <u>substantially perpendicular</u> to the axis of rotation of the rotor, and (ii) when traversing the segment, the <u>flux crosses one air gap</u>.

[1] For the most common situation in which the excitation is bipolar the magnetization is in opposite directions, but along a common axis, during the respective halves of the AC cycle.

None of the cited references or any combination thereof suggests this combination of structural features. In contrast, the presence of these features in applicants' stator as recited by claim 12 results in low core loss and thus a motor that is smaller, lighter, less expensive to construct and more versatile and efficient in operation than a motor employing a prior art stator.

As previously discussed, the low value of core loss afforded by the present stator results in a motor that is more efficient, generates less waste heat that must be dissipated, and is capable of higher operating speeds than a motor constructed with conventional steel core material. As discussed in detail by the specification, e.g. at page 16, lines 18-19 and 27-29, stators employing nanocrystalline alloy strip are especially preferred for motors wherein minimum size and high speed operation are desired. For these reasons, it is submitted that the proposed combination of Vernin et al. with the '438 patent, Mischler et al., and Frischmann, does not disclose or suggest the stator recited by present claim 12.

Accordingly, reconsideration of the rejection of claim 12 under 35 USC §103(a) as being unpatentable over the combination of the '438 patent, Mischler et al., Frischmann, and Vernin et al., is respectfully requested.

Claims 13 and 14 were rejected under 35 USC §103(a) as being unpatentable over the '438 patent, Mischler et al., Frischmann, and Vernin et al., in further view of U.S. Patent 4,881,989 to Yoshizawa et al. The Examiner has indicated that the '438 patent, Mischler et al., Frischmann, and Vernin et al. teach every aspect of the invention except the compositions set forth in claims 13 and 14 and that it would be obvious to construct the stator of the '438 patent, Mischler et al., Frischmann, and Vernin et al. with the compositions of claims 13 and 14.

Yoshizawa et al. discloses an iron-base soft magnetic alloy having a composition represented by the general formula: $(Fe_{1-a}M_a)_{100-x-y-z-\alpha-\beta-\gamma}Cu_xSi_yB_zM'_\alpha M''_\beta X_\gamma$ wherein M is Co and/or Ni, M' is at least one element selected from the group consisting of Nb, W, Ta, Zr, Hf, Ti and Mo, M" is at least one element selected from the group consisting of V, Cr, Mn, Al, elements in the platinum group,

Sc, Y, rare earth elements, Au, Zn, Sn and Re, X is at least one element selected from the group consisting of C, Ge, P, Ga, Sb, In, Be and As, and a, x, y, z, α, β, and γ, respectively, satisfy $0 \leq a \leq 0.5$, $0.1 \leq x \leq 3$, $0 \leq y \leq 30$, $0 \leq z \leq 25$, $5 \leq y+z \leq 30$, $0.1 \leq \alpha \leq 30$, $\beta \leq 10$ and $\gamma \leq 10$, at least 50% of the alloy structure being fine crystalline particles having an average particle size of 100 nm or less. This alloy is said to have low core loss, time variation of core loss, high permeability and low magnetostriction. Yoshizara et al. also discloses toroidal magnetic cores for use in various transformers, choke coils, saturable reactors, magnetic heads, and the like.

Applicants respectfully traverse the position of the Examiner that the '438 patent, Mischler et al., Frischmann, and Vernin et al. teach every aspect of the invention except the compositions set forth in claims 13 and 14. As set forth above in connection with the discussion concerning the rejection of claim 12 under 35 USC §103(a), applicants submit that the combination of the '438 patent, Mischler et al., Frischmann, and Vernin et al. does not suggest a stator having a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips; each of which layers has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap, required by present claims 13 and 14.

Moreover, the Yoshizawa et al. disclosure does not have any teaching concerning the utility of any composition therein for the construction of electric motors or other rotating electrical machines. For the reasons set forth hereinabove in connection with the rejection of claim 12, applicants submit that a skilled artisan would not be motivated to combine the Yoshizawa et al. disclosure, which is directed to electronic core applications, with the Mischler et al, Frischmann, and '438 patent disclosures, as proposed by the Examiner.

Assuming, however, that the combination of Yoshizawa et al. with '438, Mischler et al., Frischmann, and Vernin et al. could properly be made, it would not render obvious the stator called

for by applicants' claims 13 and 14. Any stator produced in light of the combined teachings of the cited references would still lack the advantageous structure and properties afforded by applicants' stator, as recited by claims 13 and 14. More specifically, any stator constructed from the combined teachings of the cited references would not contain in combination a structure having a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is <u>substantially perpendicular</u> to the axis of rotation of the rotor, and (ii) when traversing the segment, the <u>flux crosses one air gap</u>. Moreover, such a stator produced from the combined teachings of the cited references would clearly lack the advantageous magnetic properties afforded by the stator of applicants' claims 13 and 14. As set forth at page 16, lines 18-19 and 27-29 of applicants' specification, stators employing nanocrystalline alloy strip are especially preferred for motors wherein minimum size and high-speed operation are desired.

Accordingly, reconsideration of the rejection of claims 13 and 14 under 35 USC §103(a) over the combination of the '438 patent, Mischler et al., Frischmann, and Vernin et al., with Yoshizawa et al. is respectfully requested.

Claims 15-18 and 26-33 were rejected under 35 USC §103(a) as being unpatentable over the '438 patent and Mischler et al. The Examiner has indicated that the '438 patent and Mischler et al. teach every aspect of the invention except the core loss and frequency range of the magnetic material, and it would be obvious to the skilled artisan to construct the stator core of the '438 patent and Mischler et al. with the core loss defined by the formula of claim 15.

Applicants respectfully traverse this statement. As discussed hereinabove in connection with the rejection of claims 1, 2, 3, 8, 19-22, and 35 over the combination of the '438 patent and Mischler et al., each of claims 15-18 and 26-33 recites a stator having a plurality of segments. Each segment comprises a plurality of layers of amorphous metal strips, and each layer of strip has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at

substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Clearly, this combination of structural elements is not disclosed or suggested by the combined teachings of the '438 patent and Mischler et al. In fact, as previously noted, the proposed combination of the '438 patent and Mischler et al. teaches away from a stator structure that contains the elements of provisos (i) and (ii).

Moreover, applicants respectfully disagree that claims 15-18 and 26-33 amount merely to optimization of magnetic characteristics of a core. Clearly, the advantageously low core loss afforded by applicants' amorphous magnetic component is a result; not a design choice that the skilled worker can readily "dial up" on command. (See *In re Chu*, 36 USPQ 2d 1089, 1095 [Fed. Cir. 1995], holding that Chu's technical evidence relating to the frailty of fabric filters during pulsejet cleaning clearly counters the assertion that placement of the catalyst in the baghouse is merely a "design choice." Specifically, the Court held that Chu's evidence regarding the violent "snapping" action during pulse-jet cleaning, the difficulty in stitching compartments including the capacity to withstand high temperatures, and problems encountered from variable path lengths due to settling of the catalyst particles in each compartment militated against a conclusion that placement of the SCR catalyst was merely a "design choice." See also In re Gal, 980 F.2d 717, 25 USPQ2d 1076 (Fed. Cir. 1992) wherein a finding of "obvious design choice" was precluded where the claimed structure and the function it performed were different from the prior art.

Furthermore, applicants respectfully submit that, in any case, the core loss of a magnetic device is not a mere matter of engineering choice, but a consequence of (i) a complex interplay of fundamental material properties, (ii) the thermal and magnetic treatment to which the material is subjected, and (iii) specific details involving the device construction.

The Examiner has acknowledged that core loss and permeability are extrinsic properties of soft magnetic materials. An extrinsic property is one that is not uniquely specified or predictable

with a degree of certainty solely as a consequence of a composition of matter. Such properties are known to vary, possibly to a significant degree, as a result of factors such as the processing history of the material, its environment, and its geometric disposition, *inter alia*. Typical extrinsic properties of metals include mechanical strength. In contrast, intrinsic properties are substantially unaffected by processing and other external factors. Intrinsic properties include mass density and electrical conductivity.

Over the years, prior art workers in the soft magnetic materials art have devoted extensive efforts to develop materials and associated processing methods that allow desirable extrinsic properties to be realized in a desired magnetic structure. Notable among those desirable extrinsic properties so fervently sought is low core loss. The present invention is directed to an electric motor comprising a bulk magnetic component that has the outstanding combination of high mechanical strength and low core loss. Notwithstanding the significant expenditure of capital and energy during development efforts consuming more than thirty years, these requirements – high mechanical strength and low core loss – have heretofore been considered to be mutually contradictory.

Moreover, it is well recognized in the art of soft magnetic materials that excessive core losses can arise from a wide variety of factors. Highly magnetostrictive materials, including many amorphous metal compositions, are known to be highly vulnerable to externally or internally imposed stresses. In the presence of stress, contributions to core loss from both the hysteresis and eddy current mechanisms increase dramatically. Insulation of adjacent layers or particles has no effect on these contributions, which arise solely within each layer or particle.

While Mischler et al. recognizes in very general terms the desirability of obtaining low losses and that amorphous metal is promising as a low core loss material for power applications (see e.g. column 1, lines 13-16), no method, general or specific, is disclosed by Mischler et al. to accomplish that objective in the extremely demanding context of electric motor components. More specifically, there is no disclosure or suggestion of the need for processing that mitigates the

problems that are known to occur as the result of stresses imposed during manufacture. The severity of these problems in the construction of motor components is recognized, e.g., at column 1, line 55 through column 2, line 25 of U.S. Patent 5,731,649 to Caamano, which is of record in the present case. Accordingly, applicants respectfully submit that the achievement of the low core loss values recited by claims 15-18 and 26-33 is not merely a matter of design choice. Rather, it represents an unexpected consequence of the advantageous combination of structure and choice of amorphous material delineated by present claims 15-18 and 26-33. It is therefore submitted that claims 15-18 and 26-33 are patentable over the combination of the '438 patent and Mischler et al.

Accordingly, reconsideration of the rejection of claims 15-18 and 26-33 under 35 USC §103(a) as being unpatentable over the combination of the '438 patent and Mischler et al. is respectfully requested.

Claims 19-21 and 28-30 were rejected under 35 USC §103(a) as being unpatentable over the '438 patent and Mischler et al. in further view of U.S. Patent No. 4,763,030 to Clark et al.

The Clark et al. patent discloses a metallic glass ribbon having the formula $Fe_wB_xSi_yC_z$ wherein $0.78 \leq w \leq 0.83$, $0.13 \leq x \leq 0.17$, $0.03 \leq y \leq 0.07$, $0.005 \leq z \leq 0.03$, and $w+x+y+z=1$. The ribbon is annealed to remove mechanical strains and exposed to a magnetic field in the plane of the ribbon and transverse to the long axis of the ribbon. The resulting metallic glass ribbons have very large magnetic coupling coefficients ($k_{33} > 0.9$). The treated ribbons are said to be useful in magnetostrictive transducers and in passive listening devices such as hydrophones or pressure sensors. No disclosure is provided by the Clark et al patent of the use of metallic glass or amorphous metal ribbon in the construction of components of electric motors. Moreover there is no suggestion in Clark et al. that amorphous metal ribbons having high magnetomechanical coupling factor are advantageous for use in construction of an electric motor.

The Examiner has stated that the '438 patent and Mischler et al. teach every aspect of the invention, except the heat treatment, application of a magnetic field, and annealing the segments.

This statement is, respectfully, traversed. As discussed hereinabove in connection with the 103(a) rejection of claims 1, 2, 3, 8,19-22, and 35 over the '438 patent and Mischler, present claim 1 calls for a stator comprised of segments. Each of the segments comprises a plurality of layers of amorphous metal strips, and each of the strips has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Combining together the '438 patent and Mischler et al. disclosures, as proposed by the Examiner, provides no suggestion whatsoever concerning a stator that satisfies the combined features of provisos (i) and (ii). Clark et al. do not disclose or suggest use of amorphous metal in electric motor components of any kind, let alone construction of the amorphous metal stator set forth in present claims 1, 2, 3, 8,19-22, and 35. If stator were constructed in accordance with the combined teachings of the '438 patent and Mischler et al, and annealed in the manner taught by Clark et al., it would still lack the advantageous combination of structure and properties afforded by applicants' stator, as recited by claims 19-21 and 28-30. The stator would not comprise amorphous metal strips oriented such that, when traversing a segment, the flux crosses one air gap, as required by present claims 19-21 and 28-30 wherein the flux crosses only one air gap. It would not comprise amorphous metal strips oriented such that a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor. Thus, the Clark et al. teaching does not add to the teachings of the '438 patent and Mischler et al. and cannot be combined therewith to render obvious the invention recited by present claims 19-21 and 28-30.

The Examiner further indicates that claims 28-30 are method of making limitations, which are not germane to the patentability of the apparatus. As discussed hereinabove in conjunction with the rejection of claims 1, 2, 3, 8, 19-22, and 35 under 35 USC § 103(a), applicants respectfully submit that the heat treatment or annealing limitations, whether or not a magnetic field is applied, represent structural features of the stator recited in claims 28-30. As such, they are properly

germane to the determination of patentability of those claims. The Examiner has suggested that Clark, along with Yoshizawa and Vernin merely support Mischler to teach various elements of the amorphous material in magnetic cores. Applicants acknowledge that each of Clark, Yoshizawa, and Vernin provide teachings concerning amorphous metals. However, applicants are not aware of any elements disclosed by the Clark, Yoshizawa, or Vernin references (and the Examiner has pointed to none), which fairly disclose or suggest the particular features and properties called for by applicants' claims 19-21 and 28-30.

Accordingly, reconsideration of the rejection of claims 19-21 and 28-30 under 35 USC §103(a) over the '438 patent, Mischler et al. and Clark et al. is respectfully requested.

Claim 36 has been rejected under 35 USC 103(a) as being unpatentable over Mischler et al. and U. S. Patent 5,439,534 to Takeuchi et al.

Takeuchi et al. discloses a magnetic core having a low core loss and having stable characteristic in a low magnetic permeability region (e.g., a permeability of 100 to 600) obtained by applying a heat treatment in a wet atmosphere containing a limited amount of steam. The core is said to be wound or laminated ferrous amorphous ribbon. Takeuchi et al. does not provide any disclosure or suggestion of a magnetic component suitable for use in an electric motor. In addition, the low permeability which Takeuchi et al. seeks as an objective renders any device produced in accordance with his teaching unsuitable for use in an electric motor, let alone applicants' claimed motor, for which at least a moderate permeability is required and a high permeability is highly desired.

While Takeuchi et al. discloses numerical values of core loss, e.g. in Figures 2, 3, and 7, there is no indication of the conditions under which the values were measured, i.e., values of the excitation frequency and peak induction level. One skilled in the art would recognize that core losses depend strongly on these conditions (see also the present specification at page 20), so that the Takeuchi et al. disclosure at best is indicative of relative losses as a function of heat treatment

condition for the specific cores disclosed therein. Thus, Takeuchi et al. fail to disclose or suggest a component having the specific and unexpectedly low losses afforded by the component recited in claim 36. The significance of the low core loss has been set forth hereinabove in more detail, e.g., in connection with the rejection of claims 1, 2, 3, 8, 19-22, and 35.

Accordingly, reconsideration of the rejection of claim 36 under 35 USC §103(a) over the combination of Mischler et al. and Takeuchi et al. is respectfully requested.

In view of the cancellation of non-elected claims 37-50, and the remarks set forth above, it is submitted that the present application is in allowable condition. Entry of this proposed amendment, reconsideration of the final rejection of claims 1-36, and allowance of the application are, therefore, earnestly solicited.

Respectfully submitted,
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